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WO 92/09163 A1 JP 620060340 A JP 620011030 A
US 5655826 A

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INT CL^6 H04M 1/22

(54) Abstract Title
Device and method for controlling illumination of a telephone keypad by measurement of ambient light level

(57) A keypad illumination control device and method for a telephone are described. The key/pad is illuminated in accordance with ambient and/or expected illuminance. LEDs are turned on/off in accordance with ambient illuminance detected by an optical sensor in the illuminated keypad telephone, and/or expected daylight period depending on season and time.

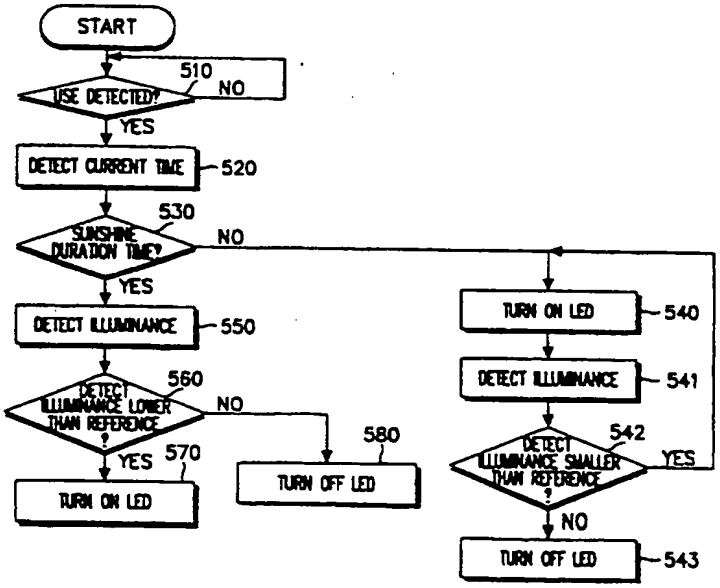

FIG. 5

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1995

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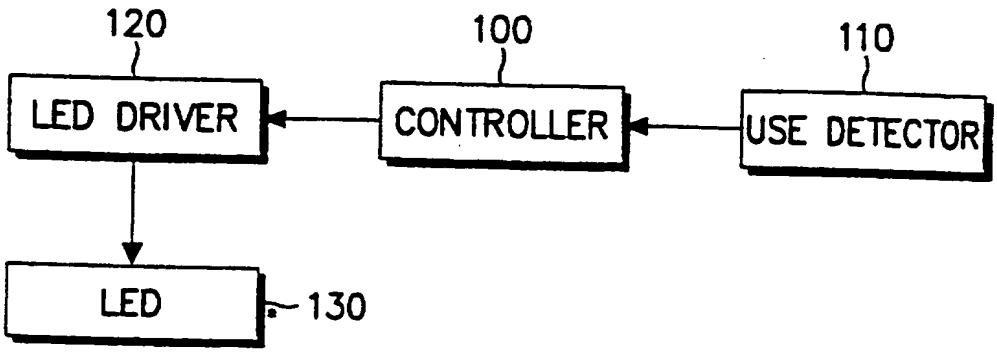
120
100
110
LED DRIVER
CONTROLLER
USE DETECTOR
LED
130

FIG. 1

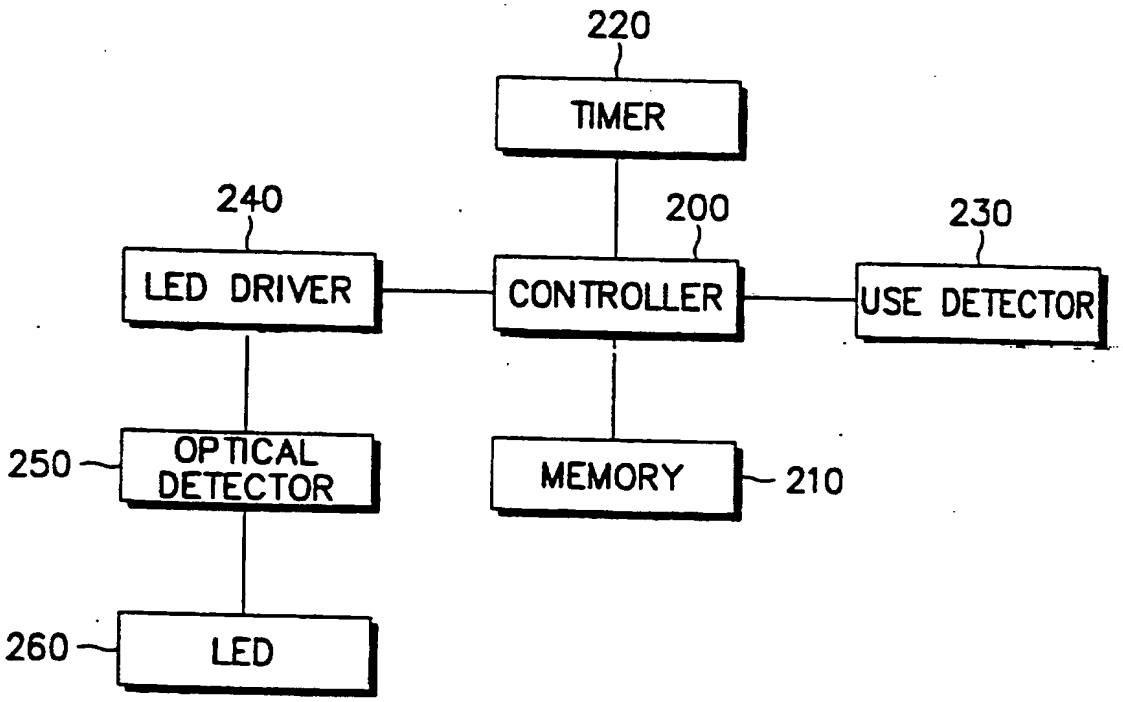
220
TIMER
240
200
230
LED DRIVER
CONTROLLER
USE DETECTOR
250
OPTICAL DETECTOR
MEMORY
210
260
LED

FIG. 2

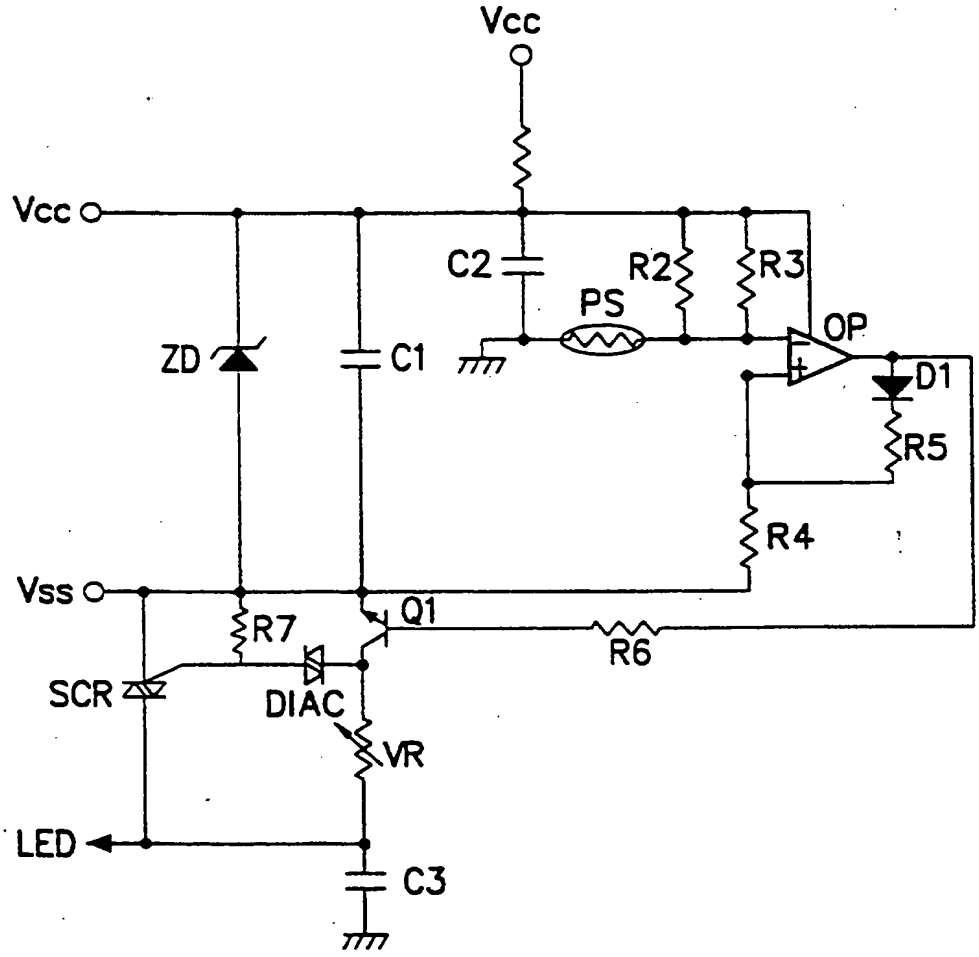

FIG. 3

FIG. 4A

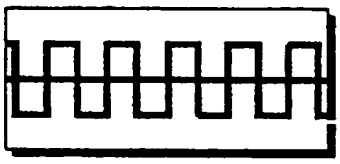

FIG. 4B

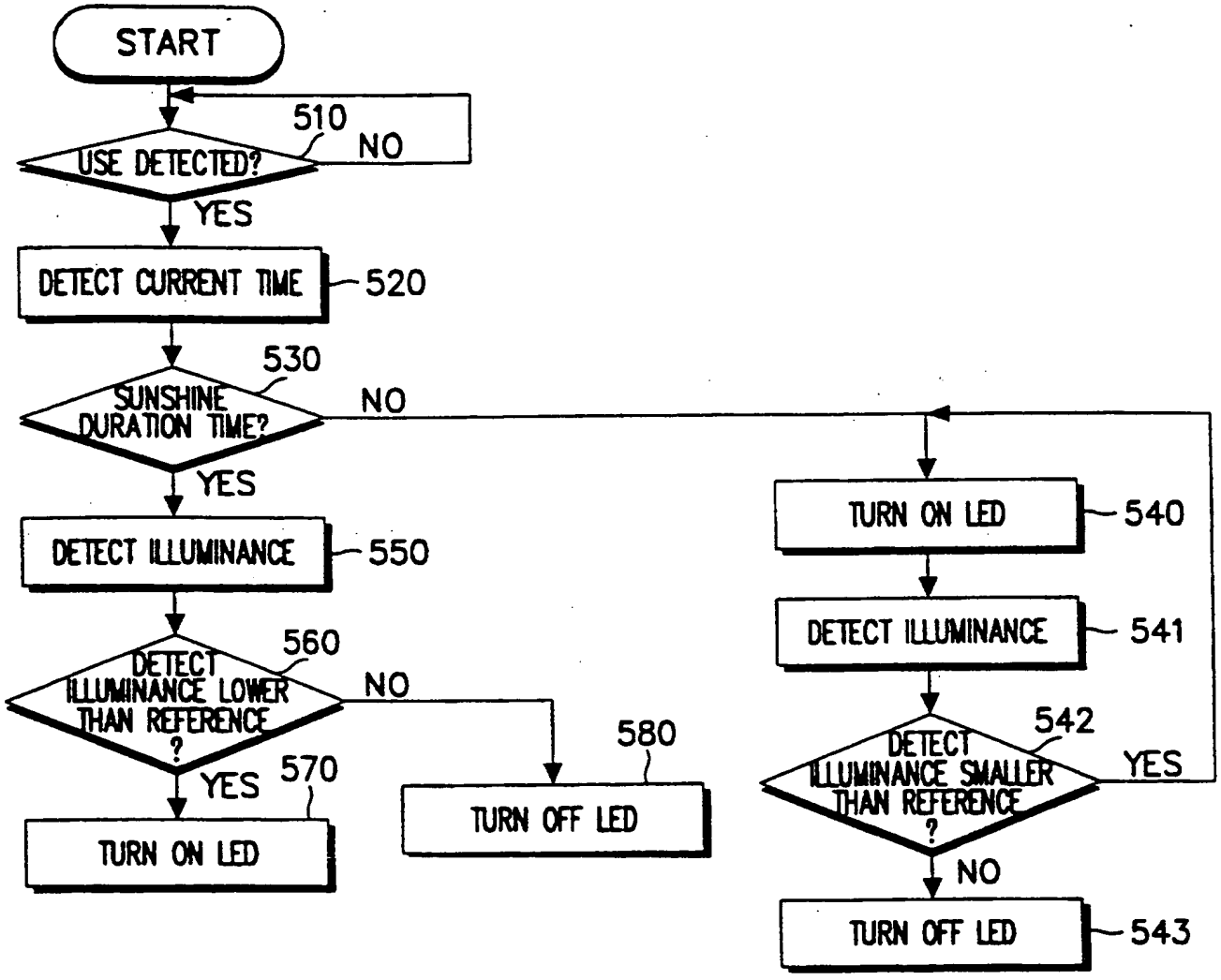
START
510
USE DETECTED?
NO
YES
DETECT CURRENT TIME
520
530
SUNSHINE DURATION TIME?
NO
YES
DETECT ILLUMINANCE
550
560
DETECT ILLUMINANCE LOWER THAN REFERENCE ?
NO
YES
570
TURN ON LED
580
TURN OFF LED
TURN ON LED
540
DETECT ILLUMINANCE
541
542
DETECT ILLUMINANCE SMALLER THAN REFERENCE ?
YES
NO
TURN OFF LED
543

FIG. 5

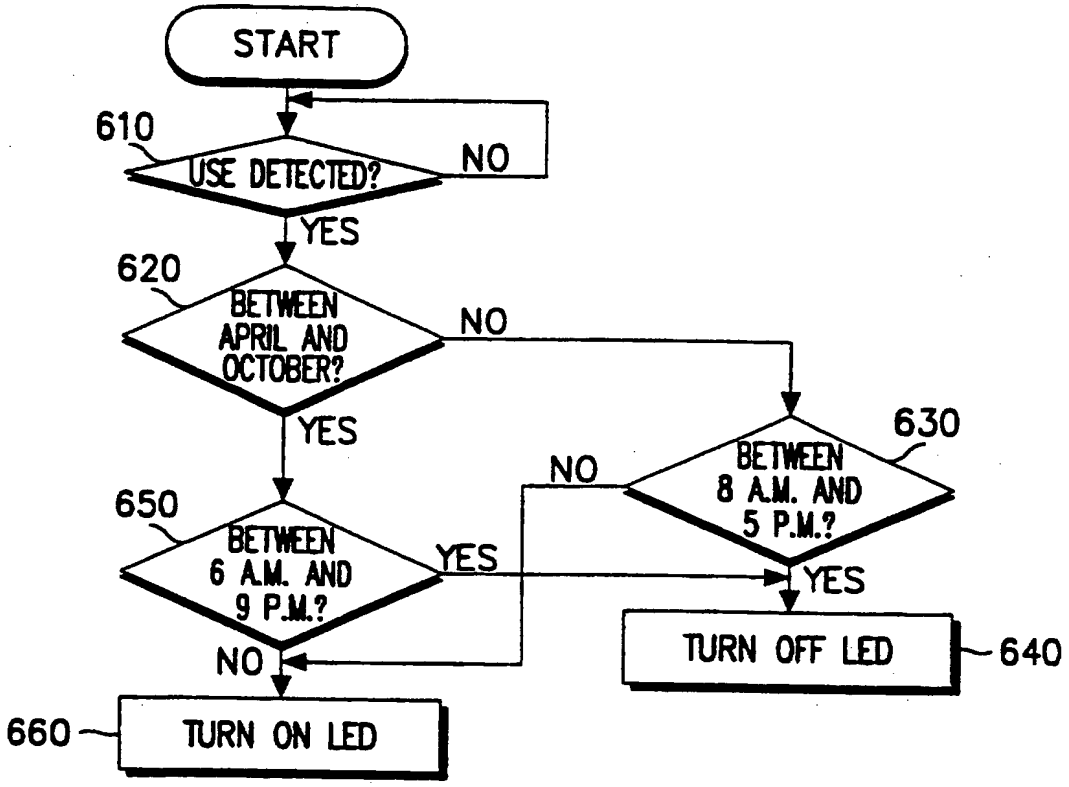
START
610
USE DETECTED?
NO
YES
620
BETWEEN APRIL AND OCTOBER?
NO
YES
630
BETWEEN 8 A.M. AND 5 P.M.?
NO
YES
650
BETWEEN 6 A.M. AND 9 P.M.?
YES
NO
TURN OFF LED
640
660
TURN ON LED

FIG. 6

TELEPHONE ILLUMINATION CONTROL

Background of the Invention

The present invention relates to an illuminated keypad telephone, and in particular, to a device and method for turning on/off a light source, such as a light emitting diode (LED), arranged to illuminate keys in an illuminated keypad telephone.

Generally, an illuminated keypad telephone enables dialling in the dark by turning on LEDs illuminating digit keys and function keys when a user tries a call.

FIG. 1 is a block diagram of an LED turning on/off device in a conventional illuminated keypad telephone. The LED turning on/off device has a controller 100, a use detector 110, an LED driver 120, and an LED 130.

Referring to FIG. 1, the operation of the conventional illuminated keypad telephone will be described. The use detector 110 detects use of a key of the illuminated keypad telephone, and applies a corresponding 'in use' signal to the controller 100. The controller 100 receives the 'in use' signal from the use detector 110, and accordingly controls the LED driver 120. The LED driver 120 turns on/off the LED 130 under the control of the controller 100. The LED 130 is turned on/off under the control of the LED driver 120. The conventional illuminated keypad telephone unconditionally turns on the LED even in high ambient light levels, thus consuming unnecessary energy. The illumination of the keypad is only required at night time, or in low ambient

illuminance levels.

Summary of the Invention

According to a first aspect of invention there is provided a keypad illumination control device for use in a telephone having one or more light sources for illuminating a keypad, comprising:

a use detector for detecting use of the telephone, and outputting an in-use signal;

a control means for receiving the in-use signal, and determining an actual ambient illumination level and/or an expected ambient illumination level and for controlling illumination of the one or more of the light sources in accordance with the actual and/or expected ambient illumination level.

Preferably, the control means comprises an optical detector for detecting an actual ambient illumination level and for turning on/off at least one light source in accordance with the detected illumination level.

Preferably, the control means comprises:

the optical detector; and

a main controller for receiving the in-use signal and for controlling a light source driver;

the optical detector being arranged to receive the signal from the light source driver, to detect an actual

ambient illumination level and to turn on/off at least one light source in accordance with the detected illumination level.

Preferably, the optical detector controls application of a driving signal from the light source driver to the light source in accordance with the detected illumination.

Preferably, the device comprises a timer for providing current time data; a memory for storing expected daylight hours, whereby the control means comprises a main controller for receiving time data from the timer and expected daylight hours from the memory and for comparing the current time with the expected daylight hours to derive an expected ambient illumination level for that time of day.

Preferably, the timer provides current date data and the memory stores expected daylight hours for one or more months or groups of months and the controller compares the current time and date data with the expected daylight data for that time of day and month or group of months to derive an expected ambient illumination level for that time of day in that month or group of months.

Preferably, the control means comprises an optical detector for detecting the actual ambient illumination level and for turning on/off at least one light source in accordance with the detected illumination level.

Preferably, the device comprises a light source driver

for outputting a control signal to control the light source, and for receiving a control signal from the main controller; the optical detector being arranged to receive the control signal from the light source driver, to detect the actual ambient illumination level and to turn on/off at least one light source in accordance with the detected illumination level.

Preferably, the optical detector controls application of the control signal from the light source driver to the light source in accordance with the detected illumination.

Preferably, at least one light source is turned on if the actual ambient illumination level detected in the optical detector is lower than a reference value, and the light source is turned off if the actual ambient illumination level detected in the optical detector is higher than the reference value.

Preferably, the optical detector comprises means for adjusting a reference value of ambient illumination.

Preferably, the light source comprises at least one LED.

In a second aspect there is provided a telephone having a keypad and a light source for illuminating the keypad and further comprising a device as described herein.

According to a third aspect of the invention a method for controlling a light source in an illuminated keypad telephone according to ambient illumination, comprising

the steps of:

detecting whether the illuminated keypad telephone is to be used;

determining an actual and/or expected ambient illumination level; and

controlling the light source in accordance with the detected and/or expected ambient illumination level.

Preferably, the step of determining actual and/or expected illumination level comprises:

determining a current time;

determining the expected daylight hours; and

comparing the current time with the expected daylight hours to derive an expected illumination level for that time of day.

Preferably, the method further comprises the steps of:

determining the current month or group of months;

determining the expected daylight hours for that month or group of months;

comparing the current time and current month or group of months with the expected daylight hours to derive an expected illumination level for that time of

day and date.

Preferably, the method further comprises the steps of:

detecting an actual ambient illumination level of the illuminated keypad telephone;

controlling the light source according to the detected ambient illumination level.

Preferably, the step of detecting actual ambient illumination follows the step of determining the expected ambient illumination level.

Preferably, if the current time falls within non-daylight hours, the step of detecting the actual ambient illumination is repeated.

Preferably, the light source is turned on if the current time falls within the expected daylight period, and the detected ambient illumination is lower than a predetermined value.

Preferably, the light source is turned off if the current time does not fall within the expected daylight period, and the detected ambient illumination is higher than the predetermined value.

Thus, the invention provides a device and method for turning on/off an LED in an illuminated keypad telephone, in accordance with ambient illuminance.

In a preferred embodiment the invention provides a device and method for turning on/off an LED in an illuminated keypad telephone, in accordance with expected daylight period.

In yet a further preferred embodiment the invention provides a device and method for turning on/off an LED in an illuminated keypad telephone, in accordance with expected daylight period and ambient illuminance.

Brief Description of the Drawings

The above, will now be described by way of example only with reference to the attached drawings.

FIG. 1 is a block diagram of an LED turning on/off device in a conventional illuminated keypad telephone.

FIG. 2 is a block diagram of a device for turning on/off an LED in accordance with ambient illuminance in an illuminated keypad telephone according to one embodiment of the present invention.

FIG. 3 is a circuit diagram of an optical detector shown in FIG. 2.

FIGs. 4A and 4B are waveform diagrams of signals occurring within the optical detector shown in FIG. 3.

FIG. 5 is a flowchart of a process for turning on/off an LED in an illuminated keypad telephone according to the embodiment of the present invention.

FIG. 6 is a flowchart of a process for turning on/off an LED in an illuminated keypad telephone according to another embodiment of the present invention.

Detailed Description of the Drawings

FIG. 2 is a block diagram of a device for turning on/off an LED in an illuminated keypad telephone in accordance with ambient illuminance, according to one embodiment of the present invention. The LED turning on/off device includes a controller 200, a memory 210, a timer 220, a use detector 230, an LED driver 240, an optical detector 250, and an LED 260.

Referring to FIG. 2, the overall operation of the illuminated keypad telephone according to one embodiment will be described. The controller 200 controls the overall operation of the illuminated keypad telephone according to programs stored in the memory 210. The memory 210 stores control programs and data for the illuminated keypad telephone, and data generated during processing the programs. The memory 210 also stores expected monthly daylight duration data. The timer 220 is a time chip integrated circuit (IC), which generates current time data (at least month or day and hour but preferably year, month, day, hour, minute, second), and outputs the time data to the controller 200.

The use detector 230 detects use or input of a key of the illuminated keypad telephone, and applies a corresponding 'in use' signal to the controller 200. The controller,

typically a central processing unit (CPU) 200, receives the 'in use' signal, and the current time data from the timer 220. It compares the current time data with the monthly daylight duration data stored in the memory 210. The controller 200 applies a control signal corresponding to the result of this comparison to the LED driver 240. The LED driver 240 applies a control signal for controlling the LED 260 to the optical detector 250 under the control of the controller 200. The optical detector 250 detects the ambient illuminance around the telephone, and may supply the control signal received from the LED driver 240 to the LED 260, according to the detected ambient illuminance.

FIG. 3 shows an optical detector 250 according to one aspect of the present invention. The detector has an optical sensor PS, an amplifier OP, a transistor Q1, a DIAC, a thyristor SCR, and other devices.

FIGs. 4A and 4B are waveform diagrams of signals within the optical detector shown in FIG. 3, respectively in the presence and absence of detected light in an optical sensor.

Referring to FIGs. 2, 3, 4A, and 4B, the operation of the device for turning an LED on/off in accordance with ambient illuminance around the illuminated keypad telephone according to an embodiment of the present invention will be described. The controller 200 receives an 'in use' signal from the use detector 230, and controls the LED driver 240. The LED driver 240 applies a driving signal Vss to the optical detector 250 under the

control of the controller 200.

Referring to FIG. 3, the optical sensor PS senses the ambient illuminance around the illuminated keypad telephone, and outputs a signal indicative of the ambient illuminance to the amplifier OP. In particular, optical sensor (PS) has a resistance which varies in accordance with illumination by light. The amplifier OP amplifies the signal received from the optical sensor PS, and outputs the amplified signal to the transistor Q1. The transistor Q1 is turned on/off according to the signal received from the amplifier OP. Transistor Q1 outputs a corresponding signal to the DIAC. The DIAC may apply a control signal corresponding to the signal received from the transistor Q1 to a gate terminal of the thyristor SCR, if the DIAC is conductive. The thyristor SCR is turned on/off in accordance with the signal received from the DIAC, and outputs signal Vss received from the LED driver 240 to the LED 260.

In high ambient illuminance, either daylight or artificial light, the optical sensor PS outputs the waveform of a very low voltage of about 2mV to an output terminal thereof, as shown in FIG. 4, because its internal resistance value is increased. The amplifier OP receives the signal shown in FIG. 4A from the optical sensor PS, amplifies the received signal, and outputs the amplified signal to the transistor Q1. The transistor Q1 is turned off upon receipt of the signal from the amplifier OP. Thus, a low signal is applied to the DIAC, and a trigger signal is not supplied to the gate terminal of the thyristor SCR, resulting in no control signal

applied to the LED 260. Therefore, when ambient illuminance is high, the optical sensor PS detects the high ambient illuminance, and blocks a control signal from being applied to the LED 260, thereby turning off the LED 260.

On the other hand, in a low-ambient illuminance, for example at night or in the dark, the optical sensor PS outputs a voltage waveform as shown in FIG. 4B to the output terminal thereof because its internal resistance value is decreased. The amplifier OP receives the signal shown in FIG. 4B from the optical sensor PS, amplifies the received signal, and outputs the amplified signal to the transistor Q1. The transistor Q1 is turned on upon receipt of the signal from the amplifier OP. Thus, the DIAC supplies a trigger signal to the gate terminal of the thyristor SCR, and a high signal is applied to the LED 260, thereby turning on the LED 260. By triggering the thyristor SCR, a closed loop including the LED 260 and a variable resistor VR is formed, and the LED 260 is turned on. Therefore, when an ambient illuminance is low, the optical sensor PS detects the low ambient illuminance, and supplies a control signal to the LED 260, thus turning on the LED 260. An ambient illuminance reference value, used for deciding the turning on/off of the LED 260, may be adjusted by adjusting the variable resistor VR.

Thus, to summarise the optical sensor (PS) has a resistance which varies in accordance with the illuminance of light. Specifically in high illuminance, the resistance of the optical sensor (PS) is high, which

causes the amplifying stage (OP) to output the voltage of about 2 mV therefrom. As a result, the transistor Q1 is not turned on. In low illuminance, the resistance of the optical sensor (PS) is low, which causes the amplifying stage (OP) to output a voltage of about 2V therefrom. As a result, the transistor Q1 is turned on, thereby turning on the LED. Furthermore, since the amplifying stage (OP) functions as a comparator, the low signal is outputted from its negative terminal when the resistance of the optical sensor is high, while the high signal is outputted from its negative terminal when the resistance of the optical sensor is low.

FIG. 5 is a flowchart of a process for turning on/off an LED according to expected daylight duration and a detected ambient illuminance for an illuminated keypad telephone according to one embodiment of the present invention.

Referring to FIGs. 2-5, the method for turning on/off an LED in accordance with monthly expected daylight duration and ambient illuminance for an illuminated keypad telephone according to an embodiment of the present invention will be described. In step 510, the controller 200 determines whether a user is to use the telephone by detecting the 'in use' signal from the use detector 230 when a key is used. When it is determined that the illuminated keypad telephone is to be used, the controller 200 receives current time data from the timer 220, and determines the current month, day, hour, and minute, for example, 14:20 on May 22, in step 520. The controller 200 determines the expected daylight duration

in that month (May) by referring to expected monthly daylight duration data stored in the memory 210. The controller further determines whether the current time received from the timer 220 corresponds to the expected daylight period, in step 530.

If the current time does not correspond to the expected daylight period, that is it is expected to be night time, the controller 200 turns on the LED 260 by controlling the LED driver 240, in step 540. The controller 200 refers to the ambient illuminance detected by the optical detector 250, in step 541, and determines whether the detected ambient illuminance is lower than a predetermined reference, in step 542.

If the detected ambient illuminance is equal to the reference, or higher, the controller 200 turns off the keypad illumination LEDs by controlling the LED driver 240, for example by preventing the sending of a control signal from the LED driver, turning the LED on in step 543.

On the other hand, if the detected ambient illuminance is lower than the reference, the controller 200 goes back to step 540, and performs a control operation to keep the LED illuminated. Steps 541-543 are performed so as to further save power in case the telephone is positioned in high ambient illuminance, such as indoors, even though the current time corresponds to expected night time.

Meanwhile, if the current time corresponds to the expected period of daylight, the controller 200 refers to

the ambient illuminance detected by the optical detector 250, in step 550.

In step 560, the controller 200 determines whether the ambient illuminance around the illuminated keypad telephone is lower than the reference. If the detected ambient illuminance is lower than the reference, the controller 200 turns on the LED 260 by controlling the LED driver, for example, by passing the control signal from the LED driver 240 to the LED, in step 570. Steps 550-570 are performed in the case where the user and the illuminated keypad telephone are positioned in the dark even though the current time corresponds to the expected daylight period.

On the other hand, if the detected ambient illuminance is the reference or higher, the controller 200 turns off the LED 260 by controlling, for example by blocking a signal from the LED driver, the LED driver 240, in step 580.

FIG. 6 is a flowchart of a process for turning on/off the LED in an illuminated keypad telephone according to another embodiment of the present invention. In this embodiment, the LED is turned on/off in accordance only with monthly expected daylight by detecting current time data.

The LED turning on/off method according to the embodiment of the present invention will be described referring to FIGs. 2-6. Here, it is assumed that the expected daylight period is between 6 a.m. and 9 p.m. from April to October, and between 8 a.m. and 5 p.m. in other months.

By fixing such rules, it may not be necessary to store individual expected daylight data for each month in the memory. Instead, simple logical relationships may be set up in a control program to determine expected daylight period for the relevant month. Such expected daylight period will need to be adapted according to the intended geographical location of the telephone.

In step 610, the controller 200 determines whether the telephone is to be used by detecting the 'in use' signal from the use detector 230. If the illuminated keypad telephone is to be used, the controller 200 receives current month data from the timer 220, and determines whether the month is between April and October, in step 620.

If the current month is not any of April to October (i.e. winter), the controller 200 determines whether the time is between 8 a.m. and 5 p.m. (i.e. daytime) by receiving current hour data from the timer 220, in step 630. If the current month is not any of April to October, and the current hour is between 8 a.m. and 5 p.m., the controller 200 applies a control signal for turning off the LED 260 by controlling the LED driver 240, as in step 640.

Meanwhile, if the current month is between April and October (i.e. summer), the controller 200 receives current hour data from the timer 220, and determines whether it is between, say, 6 a.m. and 9 p.m. (i.e. daytime), in step 650. If the current month is between April and October, and the current hour is not any of 6 a.m. to 9 p.m., or if the current month is not any of

April to October and the current hour is not between, say, 8 a.m. and 5 p.m. (night time), that is, when ambient illuminance is low, the controller turns on the LED 260 by controlling the LED driver 240, in step 660.

If the current month is not any of April to October, and the current hour is between 8 a.m. and 5 p.m., or if the current month is between April and October, and the current hour is between 6 a.m. and 9 p.m., that is daytime, when ambient illuminance is high, the controller 200 turns off the LED 260 by controlling the LED driver 240, in step 640.

As described above, the present invention advantageously reduces unnecessary power consumption by turning on/off the LED according to the measured or expected ambient illuminance of the illuminated keypad telephone. The energy consumption is further reduced by turning on/off the LED in consideration of monthly expected daylight hours in the illuminated keypad telephone. In a preferred embodiment, the daylight hours are determined by season, i.e. groups of months, rather than individual months or just time of day.

Although the present invention has been described with reference to LED light sources for illuminating the keypad, the advantages of the device and method of the present invention are equally applicable to the control of other types of light source.

Although one particular optical detector circuit has been illustrated, with reference to figure 3, any optical

detector with similar functionality may be used in the device of the present invention. The particular description of the particular optical detector circuit should not be taken to limit the scope of the present invention in any way.

The present invention is particularly useful in relation to battery powered portable telephones.

Claims

1. A keypad illumination control device for use in a telephone having one or more light sources for illuminating a keypad, comprising:

a use detector for detecting use of the telephone, and outputting an in-use signal;

a control means for receiving the in-use signal, and determining an actual ambient illumination level and/or an expected embient illumination level and for controlling illumination of the one or more of the light sources in accordance with the actual and/or expected ambient illumination level.

2. A device according to claim 1, in which the control means comprises an optical detector for detecting an actual ambient illumination level and for turning on/off at least one light source in accordance with the detected illumination level.

3. A device according to claim 2, in which the control means comprises:

the optical detector; and

a main controller for receiving the in-use signal and for controlling a light source driver;

the optical detector being arranged to receive the signal from the light source driver, to detect the

actual ambient illumination level and to turn on/off at least one light source in accordance with the detected illumination level.

4. A device according to claim 3, in which the optical detector controls application of a control signal from the light source driver to the light source in accordance with the detected illumination.

5. A device according to any preceding claim, further comprising a timer for providing current time data; a memory for storing expected daylight hours, whereby the control means comprises a main controller for receiving time data from the timer and expected daylight hours from the memory and for comparing the current time with the expected daylight hours to derive an expected ambient illumination level for that time of day.

6. A device according to claim 5, in which the timer provides current date data and the memory stores expected daylight hours for one or more months or groups of months and the controller compares the current time and date data with the expected daylight data for that time of day and month or group of months to derive an expected ambient illumination level for that time of day in that month or group of months.

7. A device according to claim 5 or 6, in which the control means comprises an optical detector for detecting the actual ambient illumination level and for turning on/off at least one light source in accordance with the detected illumination level.

8. A device according to claim 7, comprising a light source driver for outputting a control signal to control the light source and for receiving a control signal from the main controller; the optical detector being arranged to receive the control signal from the light source driver, to detect the actual ambient illumination level and to turn on/off at least one light source in accordance with the detected illumination level.

9. A device according to claim 8, in which the optical detector controls application of the control signal from the light source driver to the light source in accordance with the detected illumination.

10. A device according to any preceding claim, in which at least one light source is turned on if the actual ambient illumination level detected in the optical detector is lower than a reference value, and the light source is turned off if the actual ambient illumination level detected in the optical detector is higher than the reference value.

11. A device according to any preceding claim, in which the optical detector comprises means for adjusting a reference value against which the ambient illumination level is compared.

12. A device according to any preceding claim in which the light source comprises at least one LED.

13. A telephone having a keypad and a light source for

illuminating the keypad and further comprising a device according to any of claims 1 to 9.

14. A method for controlling a light source in an illuminated keypad telephone according to ambient illumination, comprising the steps of:

detecting whether the illuminated keypad telephone is to be used;

determining an actual and/or expected ambient illumination level; and

controlling the light source in accordance with the detected and/or expected ambient illumination level.

15. A method according to claim 14, in which the step of determining actual and/or expected illumination level comprises:

determining a current time;

determining the expected daylight hours; and

comparing the current time with the expected daylight hours to derive an expected illumination level for that time of day.

16. A method according to claim 15, further comprising the steps of:

determining the current month or group of months;

determining the expected daylight hours for that month or group of months;

comparing the current time and current month or group of months with the expected daylight hours to derive an expected illumination level for that time of day and date.

17. A method according to claim 15 or claim 16, in which the light source is turned on if the current time does not fall within the expected daylight period, and the light source is turned off if the current time falls within the expected daylight period.

18. A method according to claim 15, 16 or 17, further comprising the steps of:

detecting an actual ambient illumination level of the illuminated keypad telephone;

controlling the light source according to the detected ambient illumination level.

19. A method according to claim 18, in which the step of detecting actual ambient illumination follows the step of determining the expected ambient illumination level.

20. A method according to claim 19, in which if the current time falls within non-daylight hours, the step of detecting the actual ambient illumination is repeated.

21. A method according to claims 14 to 20, in which the light source is turned on if the current time falls within the expected daylight period, and the detected ambient illumination is lower than a predetermined value.

22. A method according to any of claims 14 to 21, in which the light source is turned off if the current time does not fall within the expected daylight period, and the detected ambient illumination is higher than a predetermined value.

23. A method substantially as described, with reference to and/or as illustrated in figures 2-6 of the accompanying drawings.

24. A device substantially as described, with reference to and/or as illustrated in figures 2-6 of the accompanying drawings.

25. A telephone having an illuminated keypad, substantially as described, with reference to and/or as illustrated in figures 2-6 if the accompanying drawings.

The Patent Office

Application No: GB 9813135.2
Claims searched: 1 to 24

Examiner: Elizabeth Rolfe
Date of search: 4 November 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): H4J (JK)

Int Cl (Ed.6): H04M: 1/22

Other: Online: WPI, JAPIO, CLAIMS

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	JP 6260340 A	(NAKAHARA) -see abstract	1 at least
X	JP 6211030 A	(OKAMOTO)- see abstract	1, 2, 3(7), 4(9)
X	US 5655826 A	(KOUNO)	1, 2, 3(7), 4(9)
X	WO 92/09163 A1	(UNIVERSAL)	1, 2, 3(7), 4(9)

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.